March 25, 2004

Mr. Gordon Bischoff, Manager
Owners Group Program Management Office
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

SUBJECT: WCAP-15831-P, "WOG RISK-INFORMED ATWS ASSESSMENT AND LICENSING IMPLEMENTATION PROCESS," JULY 2002 – WITHDRAWAL OF PREVIOUS REQUEST FOR ADDITIONAL INFORMATION (RAI) AND REQUEST FOR FURTHER CLARIFICATIONS NEEDED TO REVISE THE TOPICAL REPORT (TAC NO. MB5751)

Dear Mr. Bischoff:

By letter dated July 23, 2002, the Westinghouse Owners Group (WOG) requested that the NRC review and approve the subject topical report, WCAP-15831-P. After completing its initial evaluation, the staff issued an RAI by letter dated June 13, 2003. Subsequently, on December 11, 2003, the staff met with representatives of the WOG to discuss the scope of the RAIs on WCAP-15831-P. As an outcome of that meeting, the WOG agreed with the staff that WCAP-15831-P should not include a risk-based option (referred to as Approach 2 in the topical report) for resolving the anticipated transient without scram (ATWS) issue, but rather, should expand upon its risk-informed option, which involves the development of an ATWS-significant equipment configuration management program. The staff believes that the WOG's risk-informed option (referred to as Approach 1 in the topical report) is an appropriate direction for resolving the staff's concerns regarding defense-in-depth, although additional details need to be provided regarding such a program and its implementation. For this approach to be acceptable, it would need to include a proactive response strategy that would effectively limit the time a plant could operate in an ATWS unfavorable condition.

As a result of these discussions and pending the revisions envisioned for WCAP-15831-P, the staff has determined that it is not necessary for the WOG to respond to the staff's June 13, 2003, RAI. Therefore, the previous RAIs are being withdrawn. However, in order to help ensure that WCAP-15831-P is revised, the enclosed detailed clarifications that should be addressed within the revised topical report, were provided to the WOG prior to the meeting with the staff held on March 16, 2004, in which the WOG discussed these clarifications and committed to resolve the clarifications within 6-8 weeks of the meeting.

Therefore, please provide resolutions of the enclosed clarifications needed to revise WCAP-15831-P, to facilitate further staff review of the topical report. If further staff review results in any need for requesting additional information, it will be provided to the WOG promptly.

If you have any questions, please call me at (301) 415-8439.

Sincerely,
/RA/

Girija S. Shukla, Project Manager, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 694

Enclosure: Detailed Clarifications

cc w/encl:
Mr. James A. Gresham, Manager
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

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DETAILED CLARIFICATIONS NEEDED TO BE ADDRESSED IN REVISING

WESTINGHOUSE TOPICAL REPORT WCAP-15831-P, "WOG RISK-INFORMED ATWS

ASSESSMENT AND LICENSING IMPLEMENTATION PROCESS," JULY 2002

WESTINGHOUSE OWNERS GROUP

PROJECT NO. 694

TECHNICAL

1. To respond to the staff's concern about the potential degradation of defense-in-depth, Section 7 of WCAP-15831-P discusses an anticipated transient without scram (ATWS) configuration management approach (i.e., Approach 1) that can be implemented by utilities. The topical report (TR) provided limited details regarding the development and implementation of this approach. During meetings with the Westinghouse Owners Group (WOG), the staff agreed to review a detailed description of this approach for ensuring defense-in-depth capabilities. The staff has compiled the following topics that the WOG should address in its revision to WCAP-15831-P.

    a. The ATWS configuration management program should have as its fundamental goal, minimizing unfavorable exposure time (UET) conditions at Westinghouse plants. The TR should describe how this program will be managed, controlled, implemented, and verified to ensure UETs are minimized.

    b. The TR should clearly describe the methodology licensees would use to develop a plant- and cycle-specific ATWS configuration management program. Specifically, the TR should describe how the UETs would be calculated based on the plant- and cycle-specific parameters, such as core design and current cycle operating history (e.g., downpowers, shutdowns, etc.), and how these calculations will be controlled and verified prior to, during, and following plant startup.

    c. The plant-specific reload analysis for each cycle should ensure that the UET is minimized based on established criteria for specific conditions. For example, a 0 percent UET could be set as a core reload acceptance criteria based on the following assumed conditions:

        i. Hot full power moderator temperature coefficient;
        ii. Equilibrium xenon;
        iii. Nominal hot full power inlet temperature;
        iv. One minute of automatic control rod insertion (CRI) (i.e., 72 steps of insertion of the lead bank);
        v. All power operated relief valves (PORVs) operable; and
        vi. 100 percent auxiliary feedwater (AFW) flow available.

d. The configuration management program should be based on the effective full power days of operation at the plant.

e. The configuration management program should be designed to prevent the voluntary entry into an UET. The performance of routine surveillances and routine maintenance or testing could be reasonably scheduled and performed either prior to or after time intervals where it would cause entry into an UET. The TR should establish the criteria or conditions governing voluntarily entry into an UET. This includes criteria such as the controls and limitations on these entries, when these voluntary entries will be allowed or not allowed, what compensatory actions will be implemented prior to and during any planned voluntary entries, how long specific voluntary entries will be allowed, and what if any compensatory actions may be taken to allow an extension of the voluntary entry.

f. Entry into an UET should be permitted for performance of actions necessary to startup the plant and ensure proper operability and testing of equipment (e.g., manual rod control during startup to enable rod operability testing, etc.) However, these actions should be scheduled and controlled to prevent excessive entry into UET conditions.

g. With the understanding that unforeseen circumstances may arise, the configuration management program should limit the time UET conditions are permitted to persist for events beyond the control of the licensee (i.e., equipment failure, emergency actions, etc.). Procedures should be developed and actions should be identified such that the plant will exit an UET condition in a timely fashion. A list of proposed actions and procedures should be developed and described in the TR to ensure that time spent in an UET condition by a licensee is limited. For example, controls similar to technical specification limiting conditions of operation, action statements, and surveillance requirements (SRs) should be clearly identified to allow proper monitoring of UET conditions and minimize operations under UET conditions. Additionally, the staff requests that these compensatory actions be clearly described and supported by technical justifications which ensure that UETs are minimized.

h. The configuration management program needs to consider not just maintenance-related activities, which seems to be the only focus under the current approach, but also any time ATWS-related components/systems are out of service, unavailable, or not in their expected state/condition (e.g., testing, discovery of inoperable or failed conditions) such that they are unable to perform their functional response to an ATWS event.

i. The TR should explicitly address how plants will respond to conditions in which the ATWS-related equipment is unavailable, as identified above. The staff does not accept the concept that there are no situations that may require changing operation to a plant mode where ATWS events are no longer applicable, such as moving to Mode 3. There should be administrative requirements to proactively respond to these conditions to minimize and/or eliminate the UET, which may

include actions to lower power, shutdown, extend an outage, or terminate start-up, as appropriate.

j. The SRs that will be implemented in support of the ATWS configuration management approach should be identified and justified as acceptable in periodically assuring that ATWS-related equipment is available and functional, consistent with the cycle-specific ATWS configuration management approach matrix.

k. A detailed description of the training, tools, and procedures supplied to operators to permit them to assess the significance of plant operating conditions should be provided including time-in-life, equipment availability, and current cycle operating history (e.g., down-powers, shutdowns). From this description it should be clear that operators will have the necessary training and understanding to ensure that entry into UETs is to be minimized and that the prompt return to a non-UET condition is essential.

2. Since an ATWS is a beyond design basis accident, crediting the rod control system for limiting the peak pressures experienced may be acceptable to the staff. However, the rod control system is a control system that it is not assumed to mitigate the consequences of Chapter 15 design basis transients and accidents. Therefore, the TR should contain sufficient information to provide the staff with a reasonable assurance that the rod control system will function as assumed in WCAP-15831-P. Additionally, with regard to the assumptions used in Item 1c to determine the plant- and cycle-specific UET, the 72-step automatic CRI credit is contrary to the assumption of no CRI credit used in the basis for the ATWS rule. In order for the staff to find that this credit is acceptable, the WOG should provide technical analyses demonstrating that the rod control system will be capable of performing the required mitigative safety function under core conditions representative of an ATWS, i.e., high temperatures and pressures.

3. In Section 8.2.4, it is stated that "[r]egardless of whether this action succeeds or fails, the ATWS event can be mitigated depending on the availability of AFW and RCS pressure relief." This statement and resulting logic modeling does not appear to address the conditions for some fuel designs (e.g., bounding reactivity) in which the UET exists even with all equipment available with the exception that the rod control system is in manual (cf. Table 4-36). By definition, for the fuel designs that create an UET even with all equipment available and the rod control system in manual, a success state cannot be achieved if top events reactor trip (RT), operator action to M-G set (OAMG), and CRI all fail (or if top event [control rod] CR is failed by itself). The text and ATWS event tree logic models should be revised to address these potential fuel design-specific conditions. Also, identify if there are any other situations in which the ATWS event tree logic is not consistent with any of the analyses presented in Chapter 4 and the resulting ATWS configuration management approach.

4. With regard to Sections 4.1 through 4.5 of WCAP-15831-P, the WOG should provide a listing of key assumptions and plant conditions used in performing the deterministic analyses. Specifically, a table should be provided that contains the same parameters as

those listed in Tables 3.1 and 3.2 of NS-TMA-282, "ATWS Submittal," dated December 30, 1979. To provide a good comparison of the data, this table should consist of columns containing the parameter information for the following cases: (1) the bounding reactivity model described in WCAP-15831-P, and (2) the most limiting WOG 4-loop, 3-loop, or 2-loop plant intended to be covered by WCAP-15831-P. For Case 2, the TR should justify why the particular plant chosen is the most limiting. Additionally, for each parameter in Case 2 which is not bounded by the value used in Case 1, a justification should be provided for the difference that demonstrates that the results obtained in WCAP-15831-P are bounding for this plant.

5. Regarding the calculation of critical power trajectory (CPT) and UETs, the staff requests the following information:

   a. The CPTs were calculated for the two pressure-limiting ATWS events based on the 1979 generic Westinghouse ATWS analyses (i.e., Westinghouse letter NS-TMA-2182). The two events result in the complete loss of all main feedwater without a reactor trip and are identified as the loss-of-normal feedwater ATWS and the loss-of-load ATWS. A description of the evaluation performed should be provided to demonstrate that these events remain the limiting ATWS events for current core designs and operations.

   b. The CPT calculations are described in Section 4.1 of the TR and are based on a nuclear steam supply system (NSSS) power level of 3579 MWt. Since some plants are either currently licensed to or pursuing uprates for power levels greater than 3579 MWt, please discuss how power levels in excess of 3579 MWt can be accounted for in the CPT and UET calculations described in WCAP-15831-P to extend the validity of the TR as power levels increase. The staff also requests the WOG to provide a list of resulting limitations and conditions for the use of the TR (e.g., power levels, peaking factors, steam generator type).

   c. The CPTs are calculated using the LOFTRAN computer code and the UETs are calculated using the ANC computer code. Please demonstrate that all restrictions and limitations are satisfied for the present application of these codes.

   d. The CPT results are presented in Tables 4-1 and 4-2, but the TR does not provide a clear description of how these values are generated. For at least one representative point in the tables, please provide a detailed explanation of the methodology used to generate the CPT value. This should include the LOFTRAN generated plots for the key system parameter values used in the evaluation of CPT and a sample calculation demonstrating the method used to calculate the UETs provided in Section 4.2 of the TR. The explanation should include a detailed description of the ANC computer code model (e.g., noding, full core) and provide output plots for the key parameters generated by ANC. The WOG should also demonstrate how the ANC output is compared to the CPTs to determine UETs.

e. Table 4-2 provides the loss of load ATWS CPTs. For no PORVs available and an inlet temperature (T_{in}) of 660°F, a dash is shown in the table (i.e., no value is given). Discuss the meaning of this dashed line and how a UET is calculated for this condition. What is the UET associated with these ATWS conditions?

f. Tables 4-1 and 4-2 of the TR provide CPT results for core inlet temperatures (T_{in}) ranging from 600°F to 660°F. Discuss the basis for the range of inlet temperatures (T_{in}) used. Does this temperature range bound all ATWS scenarios?

6. For Approach 1 in Section 7, the TR states that the identified actions are proposed "... to restore defense-in-depth." While in an UET condition, four of the identified five actions restrict further activities that would not change the existing condition of being vulnerable to an ATWS event. Though these actions might prevent the plant condition from worsening, they do not consider the fact that the plant is already in an unacceptable configuration if an ATWS event occurs. Thus, these actions do not restore defense-in-depth, except for possibly the situations in which placing the rod control system in automatic could (if CRI is credited) eliminate the unfavorable configuration. The text should be revised to ensure unfavorable configurations are eliminated when they occur in accordance with the established controls supporting Item 1 above.

7. In Section 4.3.3 of WCAP-11992, it is stated that "... an initial power less than 70 percent will not result in RCS pressures greater than that corresponding to the ASME Level C service criterion ..." The staff interprets this statement as meaning that an UET is not possible at less than 70 percent power. Is this a correct interpretation and is this situation still valid for all current and expected plant cases and fuel designs (e.g., the bounding reactivity case)? If this situation is not valid for these conditions, please explain what has changed since the development (and recent efforts to get approval) of WCAP-11992 that make this statement not correct for WCAP-15831-P. If this situation is still valid, then the staff suggests that the mitigative strategies address how this power limitation could be used as a proactive response to potentially prolonged UETs, consistent with Item 1 above.

<u>EDITORIAL</u>

1. Throughout the TR, reference is made to an UET that is conditioned by a specific plant configuration (i.e., 100 percent PORV capacity available, 100 percent AFW system availability, no control rod insertion capability, and 100 percent ATWS mitigating system actuation circuitry (AMSAC) availability). Though this conditional definition was used in WCAP-11992 and was allowed as part of the current method of calculating and controlling the UET for some licensees, the staff does not believe this configuration condition is a valid aspect of the basic UET definition and can lead to misunderstandings. A more basic definition of UET would be the time in which the reactor core reactivity feedback is not sufficient to prevent RCS pressure from exceeding 3200 psig following an ATWS event. With this definition, the UET is defined by the plant's pressure response, which can change as the plant conditions and configurations change. Thus, for example, with all equipment operable a plant might not be in an UET condition, but if a specific ATWS-significant component becomes

unavailable, the plant could then immediately enter a UET condition. This definition is then very similar to the definition of unfavorable moderator temperature coefficient (MTC) that is used in the supporting technical bases of the ATWS rule (10 CFR 50.62). To avoid confusion, whenever referring to the specific plant configuration consisting of 100 percent PORV capacity, 100 percent AFW system availability, no control rod insertion capability, and 100 percent AMSAC availability, it should be identified as the "ATWS rule reference case UET" or similar phrase that distinguishes this conditional definition from the more basic UET definition. It should also be recognized that this "ATWS rule reference case UET" may be a small portion of the actual UET experienced at a plant. Please revise WCAP-15831-P accordingly.

2. The TR includes the statement that SECY-83-293 demonstrates that the installation of AMSAC reduces the risk from ATWS events to an acceptable level. It should be noted that the SECY-83-293 supporting risk analysis and other related analyses performed in support of the ATWS rule were performed in the late 1970s and early 1980s based on plant operating conditions (i.e., plant equipment configurations and availability, fuel design, etc.) at that time. These analyses were performed well before the advent of the risk-informed decision-making processes within the NRC, such as described by Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," et. al. As such, the risk analyses developed in support of the ATWS rule were relatively simplistic and made some significant assumptions regarding plant operating conditions. Current plant operating conditions may be considerably different from those assumed in these analyses. Based on the above, it may be misunderstood to state that the SECY-83-293 analyses (performed almost two decades ago) demonstrates (present tense) an acceptable level of risk from ATWS events with the installation of AMSAC, when some of the most significant assumptions of those analyses may no longer be valid. Please revise WCAP-15831-P accordingly.

3. The TR includes the statement that the ATWS Rule only required the installation of AMSAC for Westinghouse reactors and that "[the acceptability of specific plant conditions as related to the ATWS events is determined within the context of total ATWS core damage frequency, per SECY-83-293." Though the staff agrees that the only requirement for Westinghouse reactors in the ATWS Rule was the installation of AMSAC, the staff has not been able to identify in SECY-83-293 where it states the acceptability of specific plant conditions is solely determined within the context of core damage frequency (CDF). Please clarify the intent of this statement in the TR and/or revise WCAP-15831-P accordingly.

4. There is an incorrect statement in Section 2.4.2 of the TR. The statement is: "Several members of the Staff did indicate that even if Reg. Guide 1.174 is used and all the requirements are met, there could be overriding deterministic arguments that guide their final decision." In applying RG 1.174, an applicant must address probabilistic and engineering aspects of the licensing basis change. At the NRC/WOG August 23, 2000 meeting, the staff emphasized the need for the WOG to fully address the deterministic aspects in its TR and not rely solely on probabilistic arguments. Sections 2.2.1.1 and 2.2.1.2 of RG 1.174 indicate that engineering evaluations must be performed to ensure

that adequate defense-in-depth and safety margins are maintained. Please revise WCAP-15831-P accordingly.

5. Table 5-2 identifies 240 transient events that have occurred by “ATWS State” while Table 5-3 identifies only 194 transient events. Please explain the difference in the total number of transient events between these two tables and also please explain why there are a fractional number of events identified for the various ATWS states in Table 5-2. Please revise WCAP-15831-P accordingly.

6. In Section 8.2 of the TR, the clarifying bullet regarding when the engineered safety features actuation system (ESFAS) is credited seems to be internally inconsistent and confusing. The first sentence states that ESFAS is only credited if the reactor trip signal failure is not a common cause failure (CCF) that can also be associated with the ESFAS signal. However, the second sentence states that the ESFAS signal is only credited if the reactor trip fails due to failure of the control rods to fully insert into the core, which the staff assumes is referring to top event CR. Please clarify when ESFAS is and is not credited in the ATWS probabilistic analyses and revise WCAP-15831-P accordingly.

7. The relationship between top events CR and CRI needs to be clarified throughout WCAP-15831-P in accordance with the following specific comments:

   a. The phrase "control rod insertion" is not used consistently in the TR. In some cases it refers to top event "CRI" and in other cases it refers to top event "CR." Top events "RT" and "OAMG" also play a role in success or failure of control rod insertion. In particular, on page 2-3 it states that the UET is determined based on the "... success or failure of control rod insertion (CRI) ... In this case, CRI is equated to 72 steps insertion of the lead bank." However, on page 8-3 the first bullet states "Control rod insertion (CR) is addressed following success of the reactor trip signal (RT) or failure of reactor trip signal and success of the operator to trip the reactor from the motor-generator (MG) sets (OAMG)." Since these top events represent different conditions, it is important to make sure that the text is clear. Please revise WCAP-15831-P accordingly.

   b. It is noted in the TR that "... it is not necessary to address CR following success of CRI. The probability of rods failing to insert is assumed to be included in the probability of CRI failing (CR is very small compared to CRI)." The latter sentence may be true, but that does not make the former sentence true. This logic infers that there are no means of the rods failing to insert, if the actions identified in CRI are successful. However, CRI success is only dependent on the mode of the rod control system and, if it is in manual, the successful actions of the operators. It does not include the potential for the rods to fail to insert even though the system is in automatic or the operators take the correct actions. If actions related to CRI are successful, there is still the chance that the control rods will not insert. Please revise WCAP-15831-P accordingly.

   c. In Section 8.2.5 of the TR, it is stated that even "[if CR fails, it is assumed that sufficient rods have inserted to be equivalent to 72 steps of D-bank insertion ..." It is also stated that failing to get this amount of insertion "... is not credible.”

This assumption limits the pressure peak and resulting consequences of the ATWS event. The staff does not accept this assumption without significant supporting justification that there are no failure modes that could effectively result in no insertion. The staff believes, absent additional justification, that if top event CR fails, it should be assumed that no rods insert, instead of crediting some insertion even in failure, and the resulting analyses and configuration management approach should be based on this assumption (i.e., no insertion at all if top event CR fails). Please revise WCAP-15831-P accordingly.

d. The text and logic modeling would be more clear and concise if top events RT and OAMG were combined into a single top event (RT/OAMG) in the ATWS event tree to address scram success/failure and top event CRI were to address initial/partial control rod insertion success/failure. With this approach, the specific component and action failure combinations would need to be addressed via a fault tree logic model, including current top event CR as a potential failure mechanism of both of these top events. Under this streamlining of the logic model, success of the top event RT/OAMG would result in no ATWS (i.e., success sequence) and failure would lead to the CRI event. CRI success would mean there would be initially 72 steps of insertion of the lead bank to help mitigate the pressure resulting from the ATWS and the rods would continue to be inserted so that the reactor would be maintained subcritical (i.e., no need to address the long term shutdown (LTS) top event for these sequences). CRI failure would mean that there is no rod insertion and the LTS top event would need to be addressed for these sequences. This approach would seem reasonably realistic and it would not be necessary to provide additional justification for the current model assumption that even with failure of CR there are 72 steps of insertion as requested by Item 7c above. Please revise WCAP-15831-P accordingly.

8. Section 10 of the TR discusses actions a licensee must take to demonstrate that transitioning to a high reactivity core is acceptable, given that the plant is “not consistent with the bases for the ATWS rule.” Because some licensees currently operate with a positive moderator temperature coefficient and can at times operate in some of the adverse plant configurations analyzed in this TR (e.g., PORVs blocked, AFW train out of service, etc.), this discussion might be interpreted to imply that licensees are currently operating in a manner not consistent with the ATWS rule. Please discuss how licensees will track UET to ensure that the bases for the ATWS rule are maintained and revise WCAP-15831-P accordingly.